

ATOMIC ENERGY COMMISSION,
Washington, D.C., April 26, 1971.

QUESTION AND RESPONSE REGARDING AEC'S EXPERIENCE TRANSLATING
NEW TECHNOLOGIES INTO PRACTICAL APPLICATIONS

Question. Commissioner Ramey, can you submit a statement for the record of your experience and the experience of the Atomic Energy Commission on the importance of hardware development in translating new technologies into practical applications. In other words, is there a time when, in major research programs, laboratory R&D and theoretical studies reach the point of diminishing return, and more efficiencies and cost reductions are obtained through the development of components, hardware systems, and operating processes? There are a number of specific examples where research and development have made very little reduction in cost while, at the same time that the R&D is continuing, the cost of materials, hardware and operating personnel costs have increased five to seven percent per year, negating the R&D contributions to lower costs.

Answer. The development of the pressurized water reactor concept (PWR), offers an excellent history of how research and development moved from the laboratory and theoretical studies through experimental units, prototype and demonstration plants, and ultimately to the commercial phase. The technology of the PWR concept was developed initially for naval reactor plants and was first demonstrated in the Submarine Thermal Reactor, Mark I, the full-scale land based prototype for the Nautilus, which attained initial criticality on March 31, 1953. This was followed by other naval reactor plants. The first civilian power PWR demonstration plant, the Shippingport Atomic Power Station went critical on December 2, 1957, and reached full power, 60,000 KWe, on December 23, 1957.

The next major step in the PWR development for large-scale civilian power was the Yankee Nuclear Power Plant, at Rowe, Massachusetts, which went critical on August 19, 1959. This plant had an initial net capacity of 110,000 KWe, but the design permitted its output to be increased subsequently to 175,000 KWe. The next plant in this series was the San Onofre Nuclear Generating Station, Unit 1, which was constructed by the Southern California Edison Company and San Diego Gas and Electric, in cooperation with the U.S. Atomic Energy Commission.

This west coast nuclear plant went critical in 1967 and has a generating capacity of 430,000 KWe. The Shippingport, Yankee and San Onofre plants were all cooperative projects involving the power utilities and the AEC, and are representative of prototype or demonstration projects in the AEC's civilian power development program.

It is somewhat difficult at present to make a precise comparison of current costs relative to some of the earlier nuclear projects because of the recent inflation as well as the longer schedules now being encountered for project construction. There is no doubt, however, that the significant cost reductions in nuclear power prompted the heavy buying of nuclear plants by the electric utilities in 1966-1968. During this period utilities were reporting nuclear plant costs several times lower than the earlier demonstration projects. Fuel costs were also reported to be lower, and today, even with the adverse effects of inflation, nuclear fuel costs are only about half of those cited for the early nuclear power demonstration plants. The true cost picture I think is best illustrated by the overwhelming acceptance of nuclear power by the power utilities and the projections that indicate the growing role nuclear power will have in meeting the electric generating needs of the future.

Power plants of the PWR concept are now being offered on a commercial basis in the United States in unit sizes up to approximately 1,200,000 KWe. Since Shippingport, seven civilian power PWR's have been built and put into operation and 62 more were under construction or on order as of April 23, 1971. In addition to these, 110 naval reactor PWR's have been placed in service and have accumulated over 900 reactor years of operation.

The boiling water reactor (BWR), a similar light water reactor concept, has had a parallel history of development and there are now ten civilian power reactors of this concept operating with 34 more large-scale plants under construction or on order. Thus, if one considers both the BWR's and PWR's there are 113 civilian power reactors in service, under construction, or on order in the United States, having a total capacity in excess of 93 million kilowatts.

The reduction in nuclear plant capital and operating costs have resulted from a combination of factors. In addition to the diligent efforts of the propo-